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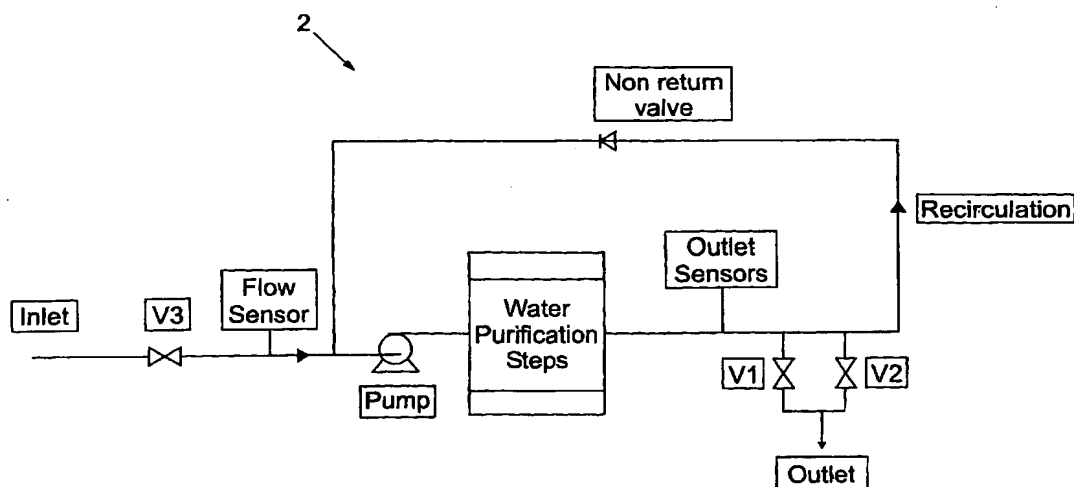
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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: WATER PURIFICATION APPARATUS



(57) Abstract: A water purification apparatus having an inlet and an outlet, and at least one water purification means thereinbetween, wherein the outlet includes at least a first and second water release means, the first release means being operable at a first flow rate, and the second release means being operable at a second flow rate, is described. Preferably, at least one water release means is operable at a relatively slow flow rate of generally up to 0.1 litre per minute, and at least one other water release means is operable at a relatively fast flow rate of, for example, up to 2 litres per minute. The present water purification apparatus provides the operator with the ability to very accurately obtain an exact volume of water desired.



WO 03/078328 A1

1     Water Purification Apparatus

2

3     The present invention relates to the control of  
4     dispensing of water from water purification  
5     apparatus and units, particularly but not  
6     exclusively for laboratory water.

7

8     Water purification units for use in laboratories  
9     have been devised that remove levels of contaminants  
10    to very low levels. They typically contain a variety  
11    of technologies that remove particles, bacteria,  
12    ionic species and organic molecules. Water is  
13    recirculated within the unit to maintain the highest  
14    purity. When a user has required water he has  
15    typically opened a valve to dispense the amount of  
16    water required. A user will typically open the valve  
17    fully at first and partially close the valve as the  
18    amount of water dispensed approaches that required.  
19    This allows the user to make sure the amount of  
20    water does not exceed fill lines typically found on  
21    laboratory equipment.

22

1 US Patent No 5925240 discloses an improved system of  
2 controlling the water output of the unit by varying  
3 the pump speed and/or the outlet valve's cross  
4 section in conjunction with a timer to give a  
5 desired amount of water. Both the pump and the valve  
6 can introduce an inaccuracy into the amount  
7 dispensed. Pump speed is typically controlled by  
8 reducing the voltage applied to the pump and  
9 correlation between this voltage and water output  
10 can vary depending upon inlet water pressure,  
11 temperature, back pressure and any gas hold up.  
12 Valve throughput can also be affected by pressure  
13 and temperature.

14  
15 WO 01/27798 A discloses the use of a flow sensor to  
16 determine the amount of water dispensed by a  
17 deionization system and charge accordingly. It also  
18 includes a safety feature wherein the flow is halted  
19 if readings from the flow and pressure sensors  
20 indicate a missing/ failed nozzle.

21  
22 EP1134190A discloses a sensor fitted to a laboratory  
23 water purification unit which measures how much  
24 water has passed through the unit. A controller  
25 changes the pump speed between two speeds and opens  
26 a dispense valve to dispense an amount of water  
27 input into the units controller by the user.

28  
29 It is an object of the present invention to provide  
30 an improved control of water dispensing from a small  
31 scale, e.g. laboratory, water purification apparatus  
32 or unit.

1     Thus, according to one aspect of the present  
2     invention, there is provided a water purification  
3     apparatus having an inlet and an outlet, and at  
4     least one water purification means thereinbetween,  
5     wherein the outlet includes at least a first release  
6     means and a second water release means, the first  
7     release means being operable at a first flow rate,  
8     and the second release means being operable at a  
9     second flow rate.

10

11    The outlet may include further water release means.  
12    One suitable release means is a valve.

13

14    Thus, the rate of release of water through the  
15    outlet can be controlled by a first flow rate, or a  
16    second flow rate, or a combination thereof; or  
17    further separate or conjoined flow rates if further  
18    water release means are used.

19

20    The flow rate of each water release means could be  
21    the same or different to the flow rate of every  
22    other water release means. Preferably, the first  
23    flow rate is different to the second flow rate.

24

25    In one embodiment of the present invention, the  
26    water release means operate in parallel. Two or  
27    more means could in addition or alternatively  
28    operate in series.

29

30    In another embodiment of the present invention, the  
31    water release means provide alternative flow paths  
32    for water through the outlet.

1 In yet a further embodiment of the present  
2 invention, each water release means is independently  
3 controllable from every other water release means.  
4

5 Preferably, at least one water release means is  
6 operable at a relatively slow flow rate of generally  
7 up to 0.1 litre per minute, although this could of  
8 course be greater, for example up to 1.0 litre per  
9 minute, and at least one other water release means  
10 is operable at a relatively fast flow rate of, for  
11 example, up to 2 litres per minute.  
12

13 Preferably, the operation and/or flow rate of at  
14 least one water release means is wholly or  
15 substantially dependant upon the operation and/or  
16 flow rate through at least one other water release  
17 means. More preferably, operation of a 'faster'  
18 flow rate water means is dependent upon operation of  
19 a relatively slow flow rate water release means.  
20

21 In a further embodiment of the present invention,  
22 the water release means are operable manually and/or  
23 automatically, and either separately or  
24 independently.  
25

26 In one arrangement, the apparatus includes a control  
27 means for controlling the outlet flow and/or flow  
28 rate through all the release means. For example  
29 operation of the control means opens a first,  
30 preferably 'slow' rate means, followed after a  
31 reasonable time period or flow by opening of a

1 second 'fast' rate means. This arrangement could be  
2 reversed at or near the end of the desired outflow.

3

4 More preferably, the degree of operation of each  
5 water release means is dependent upon the amount or  
6 volume of water to be dispensed through the outlet.

7

8 Preferably, the apparatus includes one or more water  
9 pumps. The or each pump may be separately or  
10 integrally linked with one or more of the water  
11 release means, or at least to the means for  
12 controlling the water release through the outlet.

13

14 In a further embodiment of the present invention,  
15 the apparatus includes a recirculation system to  
16 provide recirculation around at least part of the  
17 apparatus of any water treated by the or one of the  
18 water purification means, but not immediately  
19 required by the outlet. Such a recirculation unit  
20 may include one or more pressure-sustaining means  
21 such as non-return valves to maintain outlet  
22 pressure.

23

24 The apparatus may include one or more alarm means,  
25 such as a visual and/or aural alert, to provide a  
26 signal for confirmation and/or feedback to the  
27 operator of the flow rate of the outlet, and/or the  
28 flow rate of one or more of the water release means.

29

30 The apparatus of the present invention may provide  
31 for the dispensing of water by any suitable  
32 arrangement based on time, volume, etc. Preferably,

1 the apparatus of the present invention allows the  
2 operator to pre-set the volume of desired water to  
3 be dispensed, and the apparatus automatically  
4 operates the or each relevant water release means to  
5 provide a controlled (but usually variable) flow  
6 rate.

7  
8 According to a second aspect of the present  
9 invention, there is provided a method for dispensing  
10 water from a water purification apparatus having an  
11 inlet, an outlet, and at least one water  
12 purification means thereinbetween, the outlet  
13 including at least two water release means, a first  
14 release means being operable at a first flow rate,  
15 and at least a second water release means being  
16 operable at a second flow rate,

17  
18 wherein an operator organises the dispense of water  
19 from the outlet through at least one of the water  
20 release means.

21  
22 The present water purification apparatus provides  
23 the operator with the ability to very accurately  
24 obtain an exact volume of water desired.

25  
26 Where the apparatus includes a control means,  
27 possibly with an associated control switch or  
28 button, the user can preferably set the volume or  
29 amount of water desired, and the apparatus  
30 automatically controls the release means, and any  
31 included pump(s), to provide said amount exactly.  
32 The control means can be pre-programmed to calculate

1 the precise rate of flow required through the or  
2 each relevant release means.

3

4 Preferably, at least one of the water release means  
5 provides a relatively slow flow rate, particularly,  
6 but not exclusively, useable at the beginning and  
7 end of a water dispensing operation, whilst the  
8 second water release means provides water at a fast  
9 flow rate, and is generally more used during the  
10 middle of the operation for dispersement of water.

11

12 An embodiment of the present invention will now be  
13 described by way of example only and with reference  
14 to the accompanying Figure 1, being a block-flow  
15 diagram of operation of an apparatus according to  
16 one embodiment of the present invention.

17

18 Referring to the drawing, a unit 2 operates with  
19 feedwater being drawn into the unit 2 via an inlet  
20 and a solenoid valve, V3. The water passes through a  
21 series of purification steps and past sensors for  
22 temperature and resistivity before being dispensed  
23 to an outlet via two release valves V1 and V2.

24

25 When water is not required, the pump recirculates  
26 the water to be purified through the purification  
27 steps maintaining it at the highest quality  
28 possible. A non return valve is included in the  
29 recirculation tubing to both prevent bypass of water  
30 to the outlet valves V1 and V2 without it passing  
31 through the purification steps, and also to provide



1 a system pressure at which the water can be  
2 dispensed.

3  
4 Water can be dispensed by turning a switch (not  
5 shown), which firstly, opens the low flow, trickle  
6 valve V2. This will dispense dropwise initially with  
7 an audible 'click' for each drop dispensed. As the  
8 switch is turned the drops and associated 'clicks'  
9 increase in rate, until the unit 2 dispenses a low  
10 continuous flow. On further turning, the unit opens  
11 the larger valve V1 increasing the dispense rate. On  
12 yet further turning the pump speed is increased  
13 causing water to be dispensed at a rate up to the  
14 maximum flowrate of for example two litres per  
15 minute. Pushing the switch closes the valves and  
16 reduces the pump speed. When dispensing, water is  
17 drawn into the unit via V3. When not dispensing, or  
18 when dispensing at a low rate, the unrequired water  
19 is recirculated around the loop.

20  
21 When the operator wishes to dispense a fixed volume  
22 of purified water, he will input the amount, from,  
23 for example, 0.1 to 60 litres, via an operator  
24 interface on the unit 2 (not shown). When ready, the  
25 unit will open the valves V1 and V2 and increase  
26 pump speed as appropriate to the volume being  
27 dispensed. Water will be drawn into the unit via V3  
28 and the flow sensor will transmit the rate of flow  
29 to the processor via a series of pulses. The  
30 processor will integrate the pulses and from this  
31 determine the amount of water dispensed. When the  
32 amount of water dispensed approaches the amount

1 specified by the operator, the pump will slow down  
2 followed by valve V1 closing and finally valve V2  
3 closing. The pump will continue to recirculate water  
4 around the loop.

5  
6 The use of the two valves and variation in pump  
7 speed allows a more controlled outlet measure as the  
8 amount of water approaches that required. As the  
9 water reaches the fill point of the vessel being  
10 filled, then the user is still able to stop the  
11 dispense without excessive water dispense. The user  
12 may also be able to reduce the flow by turning the  
13 switch in the opposite direction so that a slow drip  
14 is dispensed as the water level approaches the fill  
15 line typically found on glassware.

1     Claims

2

- 3     1.    A water purification apparatus having an inlet  
4           and an outlet, and at least one water  
5           purification means thereinbetween, wherein the  
6           outlet includes at least a first release means  
7           and a second water release means, the first  
8           release means being operable at a first flow  
9           rate, and the second release means being  
10          operable at a second flow rate.
- 11
- 12     2.    A water purification apparatus as claimed in  
13           Claim 1 wherein the outlet includes further  
14           water release means.
- 15
- 16     3.    A water purification apparatus as claimed in  
17           Claims 1 or 2 wherein the rate of release of  
18           water through the outlet is controlled by the  
19           first flow rate, or the second flow rate, or a  
20           combination thereof.
- 21
- 22     4.    A water purification apparatus as claimed in  
23           any one of the preceding Claims wherein the  
24           first flow rate is different to the second flow  
25           rate.
- 26
- 27     5.    A water purification apparatus as claimed in  
28           any one of the preceding Claims wherein the  
29           water release means operate in parallel.
- 30
- 31     6.    A water purification apparatus as claimed in  
32           any one of the preceding Claims wherein the

1 water release means provide alternative flow  
2 paths for water through the outlet.  
3

4 7. A water purification apparatus as claimed in  
5 any one of the preceding Claims wherein each  
6 water release means is independently  
7 controllable from the or every other water  
8 release means.  
9

10 8. A water purification apparatus as claimed in  
11 any one of the preceding Claims wherein at  
12 least one water release means is operable at a  
13 relatively slow flow rate and at least one  
14 other water release means is operable at a  
15 relatively fast flow rate.  
16

17 9. A water purification apparatus as claimed in  
18 Claim 8 wherein the at least one water release  
19 means is operable at a relatively slow flow  
20 rate of up to 0.1 litres per minute, the at  
21 least one other water release means is operable  
22 at a relatively fast flow rate of up to 2  
23 litres per minute.  
24

25 10. A water purification apparatus as claimed in  
26 any one of the preceding Claims wherein the  
27 operation and/or flow rate of at least one  
28 water release means is wholly or substantially  
29 dependant upon the operation and/or flow rate  
30 through at least one other water release means.  
31

- 1      11. A water purification apparatus as claimed in  
2            any one of Claims 8 to 10 wherein the operation  
3            of the relatively fast flow rate water means is  
4            dependent upon operation of the relatively slow  
5            flow rate water release means.  
6
- 7      12. A water purification apparatus as claimed in  
8            any one of the preceding Claims wherein the  
9            apparatus includes one or more water pumps.  
10
- 11     13. A water purification apparatus as claimed in  
12            Claim 12 wherein the or each pump is linked  
13            with one or more of the water release means.  
14
- 15     14. A water purification apparatus as claimed in  
16            any one of the preceding Claims wherein the  
17            water release means are operable automatically.  
18
- 19     15. A water purification apparatus as claimed in  
20            any one of the preceding Claims wherein the  
21            apparatus includes a control means for  
22            controlling the outlet flow and flow rate  
23            through all the release means.  
24
- 25     16. A water purification apparatus as claimed in  
26            Claim 15 wherein the control means is pre-  
27            programmed to calculate the rate of flow  
28            through each release means.  
29
- 30     17. A water purification apparatus as claimed in  
31            any one of the preceding Claims wherein the  
32            degree of operation of each water release means

1 is dependent upon the amount or volume of water  
2 to be dispensed through the outlet.

3

4 18. A water purification apparatus as claimed in  
5 any one of the preceding Claims wherein the  
6 apparatus includes a recirculation system to  
7 provide recirculation around at least a part of  
8 the apparatus of any water treated by the or  
9 each water purification means.

10

11 19. A water purification apparatus as claimed in  
12 Claim 18 wherein the recirculation unit  
13 includes one or more pressure-sustaining means  
14 to maintain outlet pressure.

15

16 20. A water purification apparatus as claimed in  
17 any one of the preceding Claims wherein the  
18 apparatus includes one or more alarm means to  
19 provide a signal concerning the flow rate of  
20 the outlet and/or the flow rate of one or more  
21 of the water release means.

22

23 21. A water purification apparatus as claimed in  
24 any one of the preceding Claims adapted to  
25 provide a pre-set volume of water by automatic  
26 operation of one or each relevant water release  
27 means.

28

29 22. A water purification apparatus as claimed in  
30 any one of the preceding Claims wherein the  
31 release means are valves.

32

- 1     23.   A method for dispensing water from a water  
2           purification apparatus as defined in any one of  
3           Claims 1 to 20 wherein the dispense of water  
4           from the outlet is controlled through at least  
5           one of the water release means.  
6
- 7     24.   A method of dispensing water as claimed in  
8           Claim 23 wherein the apparatus includes a pump  
9           which is automatically controlled by a control  
10          means.  
11
- 12    25.   A method for dispensing water as claimed in  
13          Claim 23 wherein the water is provided by a  
14          first water release means having a relatively  
15          fast flow rate followed by a second water  
16          release means having a relatively slow flow  
17          rate.  
18
- 19    26.   A method of dispensing water as claimed in  
20          Claim 24 wherein the second water release means  
21          provides an initial relatively slow  
22          dispensement prior to the dispensement from the  
23          first release means.  
24
- 25    27.   A water purification apparatus substantially as  
26          herein described and with reference to Figure  
27          1.

1 / 1

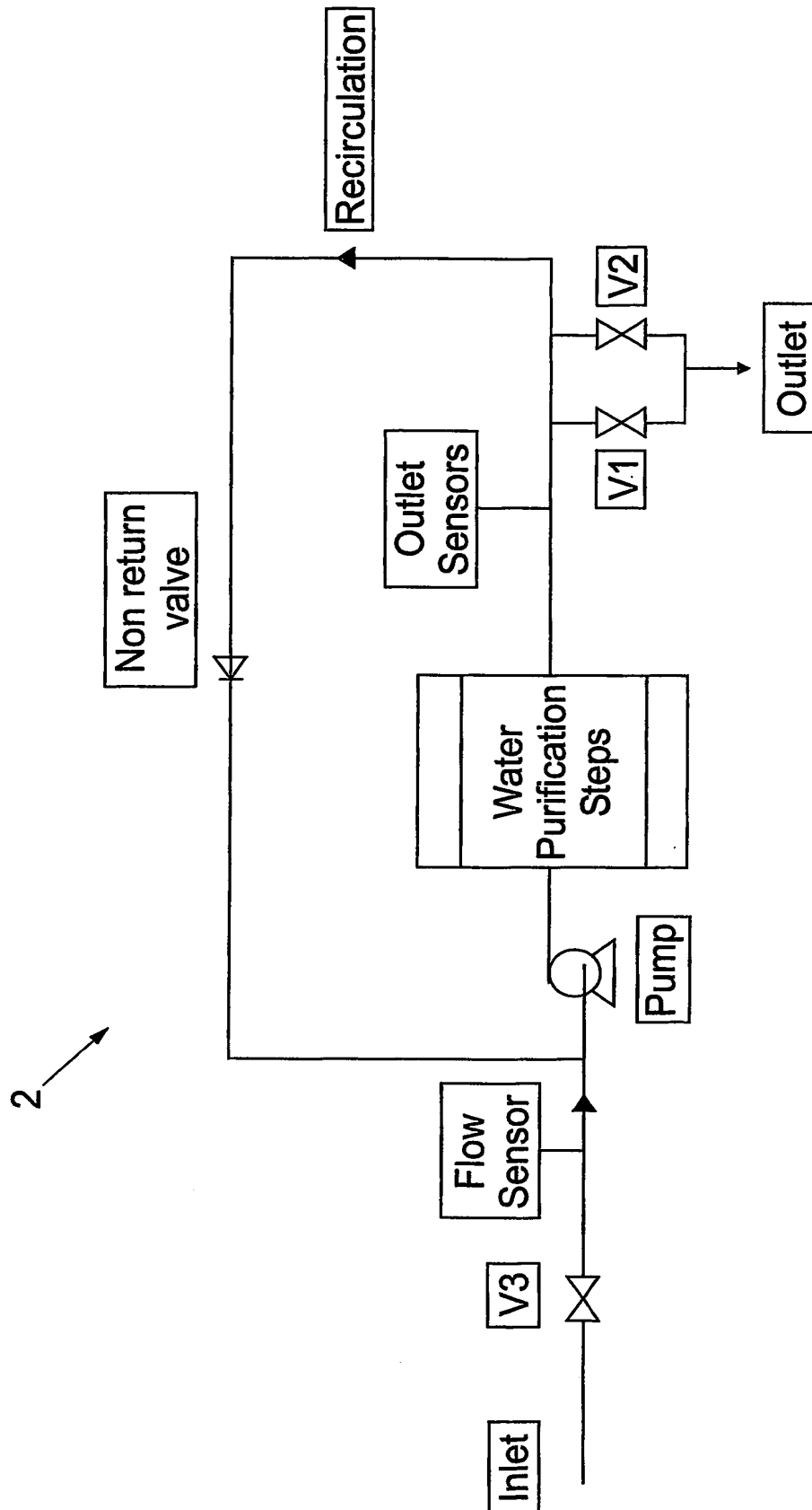


Fig. 1



## INTERNATIONAL SEARCH REPORT

International Application No  
PCT/GB 03/00985

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 C02F1/00

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
IPC 7 C02F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 935 441 A (SIU KITTY K ET AL) 10 August 1999 (1999-08-10) column 4, line 9 - line 62; figure 1	1-27
X	WO 01 19957 A (CHANDLER JAMES W) 22 March 2001 (2001-03-22) page 6, line 10 -page 7, line 11 page 8, line 1 - line 24; figure 1	1-27
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A	EP 1 136 447 A (BARNSTEAD THERMOLYNE CORP) 26 September 2001 (2001-09-26) column 7, line 25 -column 8, line 7; figure 6A	1-27



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

\* Special categories of cited documents :

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Date of the actual completion of the international search

4 June 2003

Date of mailing of the international search report

12/06/2003

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# INTERNATIONAL SEARCH REPORT

International Application No  
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